II. REMARKS

With the above amendments, claims 1-5, 28-30 and 140 have been amended to improve clarity, and claim 141 has been newly added.

Claims 1-5, 28-30 and 140, respectively, have been amended to recite "the copper alloy has an average grain diameter of 200 μm or less in a macrostructure obtained when melted and solidified during casting" as supported by the condition (7) on ¶ [0021], and ¶ [0023] of the Applicant's specification filed on January 14, 2009 (hereinafter "Applicant's specification).

New independent claim 141 incorporates subject matter of claim 1 and further recites addition conditions, for providing the casted copper alloy having the claimed metal structure and grain size, i.e., "wherein a cooling rate in the melt-solidification of casting has a range from 10^{-2} to 10^{4}°C/sec, wherein casting starts at 20 to 250°C higher than a liquidus temperature of the copper alloy or below 1150°C, and wherein when Zr is added in a form of Cu-Zr alloy or Cu-Zn-Zr alloy, before casting." Support for the additional conditions recited in new independent claim 141 may be found on ¶¶ [0033], [0048], [0046] and [0047] of Applicant's specification.

The present amendment adds no new matter to the above-captioned application.

A. The Invention

The present invention pertains broadly to a casted copper alloy, such as may be used to make various products. In accordance with an embodiment of the present invention, a casted copper alloy is provided that has features recited by independent claim 1. In accordance with another embodiment of the present invention, a casted copper alloy is provided that has features recited by independent claim 140. In accordance with still another embodiment of the present invention, a casted copper alloy is provided that has features

recited by independent claim 141. Various other embodiments, in accordance with the present invention, are recited by the dependent claims.

An advantage provided by the various casted copper alloy embodiments of the present invention is that a casted Cu-Zn-Si alloy is provided that has significantly improved properties, such as castability, mechanical properties, corrosion resistance, machinability and/or workability.

B. The Rejections

Claims 1, 3, 5, 7, 8, 10, 11, 13, 16, 26, 27, 29, 35, 37-42, 44, 45, 47, 51, 54, 56, 57, 60, 70, 72 and 134-140 stand rejected under 35 U.S.C. § 102(b) as anticipated by Parikh et al. (U.S. Patent 4,047,978, hereinafter "Parikh '978").

Claims 2, 4, 6, 12, 28, 30-34, 36, 43, 46, 48, 49, 53, 55, 58, 59, 69, 71, 73-75 and 80 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Parikh '978 in view of Yamazaki et al. (U.S. Patent 4,710,349, hereinafter "Yamazaki '349").

Claims 76-79 and 81 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Parikh '978.

Claims 14, 21-25, 52, 62, 84, 85, 90-93, 96-99, 102, 103, 105, 107, 109, 111, 112, 114, 115, 117, 119, 121, 124, 126, 128, 130, 131 and 133 stand rejected under 35 U.S.C. § 103 as unpatentable over Parikh '978 in view of Oishi (U.S. Patent Application Publication No. US 2002/0159912 A1, hereinafter "Oishi '912").

Claims 50, 61, 63, 82, 83, 88, 89, 94, 95, 100, 101, 104, 106, 108, 110, 113, 116, 118, 120, 122, 123, 125, 127, 129 and 132 stand rejected under 35 U.S.C. § 103 as unpatentable over Parikh '978 in view of Yamazaki '349, and further in view of Oishi '912.

Claims 64, 66, 68 and 72 stand rejected under 35 U.S.C. § 103 as unpatentable over Parikh '978 in view of Yamazaki '349, and further in view of Ohno (U.S. Patent 4,515,204, hereinafter "Ohno '204").

Claims 65 and 67 stand rejected under 35 U.S.C. § 103 as unpatentable Parikh '978 in view of Ohno '204.

Claims 15, 17, 86 and 87 stand rejected under 35 U.S.C. § 103 as unpatentable over Parikh '978 in view of Oishi '912 and Ohno '204.

Claims 18, 19 and 20 stand rejected under 35 U.S.C. § 103 as unpatentable over Parikh '978.

Applicant respectfully traverses the Examiner's rejections and requests reconsideration of the above-captioned application for the following reasons.

C. Applicant's Arguments

1. The Section 102 Rejection

Anticipation under 35 U.S.C. § 102 requires showing the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim. Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick, 221 U.S.P.Q. 481, 485 (Fed. Cir. 1984).

In this case, the Examiner has failed to establish a prima facie case of anticipation against claims 1, 3, 5, 7, 8, 10, 11, 13, 16, 26, 27, 29, 35, 37-42, 44, 45, 47, 51, 54, 56, 57, 60, 70, 72 and 134-140, and new independent claim 141 because Parikh '978 does not teach, or suggest, each and every limitation recited by these claims, including independent claims 1 and 140, and new independent claim 141.

i. <u>Parikh '978</u>

Parikh '978 discloses copper based alloys with strength and bend properties. Parikh '978, col. 1, lines 8-10.

Parikh '978 does not teach, or suggest, the "casted copper alloy" as recited by **claims 1 and 140**, and **new claim 141**, **(i)** "the copper alloy has an average grain diameter of 200 μm or less in a macrostructure obtained when melted and solidified during casting," or **(ii)** "the copper alloy has a metal structure that contains α phase and one or more additional phases selected from the group consisting of (i) K phase, (ii) γ phase, (iii) K phase and γ phase, (iv) β phase, and (v) μ phase, and having relation of, in terms of a content of a phase b, [b]%, in an area rate, $f4 = [\alpha] + [\gamma] + [K] \geq 85$ and $f5 = [\gamma] + [K] + 0.3[\mu] - [\beta] = 5$ to 95."

Parikh '978 does not teach, or suggest, the limitation of **claim 8**, namely, **(iii)** "wherein, when melted and solidified during casting, a primary crystal is the α phase," the limitation of **claim 10**, namely, **(iv)** "wherein, when melted and solidified, the copper alloy comprises a dendrite network having a divided crystalline structure, and further comprises a two-dimensional grain shape selected from the group consisting of a circular shape, a non-circular shape near to the circular shape, an elliptical shape, a criss-cross shape, an acicular shape and a polygonal shape," or the limitation of **claim 140**, namely, **(v)** "wherein, when melted and solidified during casting, a peritectic reaction is generated."

Parikh '978 also does not teach, or suggest, the limitation of **new claim 141**, namely, **(vi)** "wherein the copper alloy is provided when a cooling rate in the melt-solidification of casting has a range from 10^{-2} to 10^{4}°C/sec, when casting starts at 20 to 250°C higher than a liquidus temperature of the copper alloy or below 1150°C, and when Zr is added in a form of Cu-Zr alloy or Cu-Zn-Zr alloy, before casting."

Parikh '978 does not disclose the "casted" copper alloy having an average grain diameter of 200 μm or less in a macrostructure obtained when melted and solidified during casting, as recited in claims 1 and 140, and new claim 141.

First, the presently claimed invention is directed to a casted copper alloy obtained when melted and solidified during casting, having grains of an average grain diameter of 200 μm or less. On the other hand, Parikh '978 is directed to a hot worked material obtained by carrying out several steps after casting, having grains of a grain size of less than 0.015 mm (i.e., 15 μm).

According to Parikh '978, in order to produce Parikh's hot worked material having grains of a grain size of less than 15 μm, it is necessary that the base alloy of Parikh '978 be subsequently subjected to a plastic deformation process including hot rolling and recrystallization, after casting. Parikh '978, col. 3, lines 33-42. For example, the alloys of Examples III and VII in Parikh '978 are processed, after the casting process, in accordance with the following order: hot roll, cold roll; recrystallization or RGR anneal; cold roll (CR(1)); ready to finish or RF anneal; and final cold roll to final gage. See Parikh '978, Tables III and X.

It is well known in the art that in order to achieve small grain size in copper alloys, e.g., Parikh's grain size of less than 15 μm, the casted alloy obtained by casting is subjected to a plastic deformation process. See Exhibits B-D attached herewith. "Exhibit B" (Metals Handbook Ninth Edition, Volume 9, Metallography and Microstructures, American Society for Metals, pp. 641-642) shows e.g., the casted alloy 36000 shown in Figs. 19 and 20, the composition of which falls within the range of the alloy of Parikh '978 except for Pb. The casted alloy 36000 has a grain size of approximately 5000 μm. "Exhibit C" (Metals Handbook 8th Edition, Volume 7, Atlas of Microstructures of Industrial Alloys, American Society for Metals, pp. 290 & C-2) shows e.g., the plastic deformation process of the alloy

360 shown in Fig. 2405 having the same composition as the alloy casting 36000 described above and thus as the alloy of Parikh '978. The macrostructure of the alloy 360 on page C-2 is obtained when a cylindrical billet (diameter 240 mm) is hot extruded into a rod (diameter 40 mm) at unknown temperature. The part of metal flow (①) is subjected to a plastic deformation and the resulting grains become small enough to be invisible to a naked eye (i.e., a few or several hundreds micrometers). The part not subjected to the plastic deformation (②) remains as a casting itself and has a grain size of about 5000 μm. "Exhibit D" (Metals Handbook 8th Edition, Volume 7, Atlas of Microstructures of Industrial Alloys, American Society for Metals, p. 286) shows e.g., the grain size of the alloy 260 shown in Fig. 2362, after recrystallization annealing following cold rolling, which corresponds to the plastic deformation process disclosed by Parikh '978. The resulting material after cold rolling and recrystallization annealing of the alloy 260 has a grain size of 15 μm.

Therefore, persons of ordinary skill in the art would know that Parikh's hot worked material having grains of a grain size of less than 15 μm is only achieved by carrying out significant and numerous steps of plastic deformation after the casting process. In short, the disclosed grain size is <u>not</u> for a "casted alloy." In other words, Parikh does not disclose a "casted copper alloy" having the claimed features.

In contrast, the "casted copper alloy" according to present claims 1, 140 and 141 of the present application, has grains of an average grain diameter of 200 μm or less produced <u>during the melt-solidification of the casting process</u>. Applicant's specification, the condition (7) of ¶ [0021], and ¶ [0023]. A "casted copper alloy" within the claimed features present in the case as claimed has numerous advantages over a plastically deformed alloy as described below.

In view of the above disclosures and discussions, persons of ordinary skill in the art instantly realized that the claimed "casted copper alloy" (having grains of an average grain

diameter of 200 μm or less) obtained by casting is an entirely different material from Parikh's hot worked material (having grains of a grain size of less than 15 μm), heavily worked under the plastic deformation process. In short, Parikh '978 does not disclose the claimed "casted" copper alloy having grains of an average grain diameter of 200 μm or less.

Second, conventionally, when a copper alloy is melted and solidified during casting, a desirable level of grain refinement, i.e., an average grain size of 200 μm or less, cannot be achieved, because the content of Zr is greatly influenced by other elements. Applicant's specification, ¶ [0005]. This is also evidenced by "Exhibit A" filed with Amendment (C) on January 14, 2009 (copy attached), wherein Exhibit A shows the alloys illustrated in Figs. 7 and 9 having the grain size which ranges from 0.3 mm to 1 mm, even after carrying out the grain refinement.

On the other hand, the "casted copper alloy" according to claims 1, 140 and 141 of the present application has an average grain diameter of 200 μm or less in a macrostructure obtained when melted and solidified during casting. For example, Example 79 illustrated in Figure 1A of the present application shows grains in the macrostructure of the casted alloy of the present invention that are generally too small (i.e., 25 μm) to be apparent to the naked eye. See Applicant's original disclosure, Table 16. Thus, the grain size exhibited by alloy of the present invention is even smaller than the smallest grain sizes of representative casted alloys of the prior art (i.e., "Exhibit A").

Therefore, one of ordinary skill in the art would instantly know that the claimed casted copper alloy having an average grain size of 200 μm or less in a macro structure obtained during melt-solidification of casting is surprising and unexpected in view of Parikh '978 and any other of references of record.

Third, according to claims 1, 140 and 141 of the present application, the "casted copper alloy" having an average grain diameter of 200 μm or less can significantly improve

castability. Applicant's specification, ¶¶ [0083] and [0084]. For example, in the present application, Examples 47 and 49 having a grain size of 15 μm and 150 perform good and normal castabilities, respectively (Tables 15 and 21), whereas Comparative Examples 201 and 202 having a grain size of 1500 μm and 600 μm, respectively, perform bad castability (Tables 17 and 23). In view of the above disclosure, it is apparent that in order to improve castability, a threshold value of a grain size of a casting is 200 μm or less. However, the claimed casted copper alloy having a grain size of 200 μm or less as well as the good castability resulting from the claimed casted copper alloy are <u>neither</u> taught <u>nor</u> suggested by Parikh '978 and any other of references of record.

For these reasons, the Examiner's rejection regarding the casted copper alloy having the "average grain diameter" of 200 μm or less, recited by claims 1 and 140, and now new claim 141, is untenable and must be withdrawn.

With respect to the metal structure having relations of f4 and f5 recited in claims 1 and 140, and now new claim 141, the Examiner contends that since the copper alloy as taught by Parikh is made by the same method as taught in the instant specification, it would be expected that Parikh and the instant claims would result in the same properties and the same phases (Office Action, dated March 3, 2010, at 3, lines 13-15 and at 6, lines 1-3). The Examiner's inherency argument with respect claims 1 and 140, and now new claim 141 is improper and untenable, and must be withdrawn for the following reasons.

The Federal Circuit has held that a reference may inherently teach subject matter not explicitly disclosed by the reference when the disclosure is sufficient to show that the implicit subject matter is the natural result flowing from the explicitly disclosed subject matter. <u>Continental Can Co. USA Inc. v. Monsanto Co.</u>, 20 U.S.P.Q.2d 1746, 1749 (Fed. Cir. 1991). However, inherency cannot be established by mere probabilities or possibilities, and the mere fact that a certain thing may result from a given set of circumstances is insufficient. <u>Id</u>. The

Federal Circuit has ruled that inherency is a question of fact. In re Napier, 34 U.S.P.Q.2d 1782, 1784 (Fed. Cir. 1995). Also, it is a well-settled proposition that obviousness cannot be predicated on what is unknown so that a retrospective view of inherency with respect to what a combination of disclosures might achieve is impermissible. In re Newell, 13 U.S.P.Q.2d 1248, 1250 (Fed. Cir. 1989).

In this case, Parikh '978 does not disclose the metal structure that contains α phase and one or more additional phases selected from the group consisting of (i) K phase, (ii) γ phase, (iii) K phase and γ phase, (iv) β phase, and (v) μ phase, having relation of f4 and f5, as recited in claims 1 and 140, and new claim 141.

Secondly, Parikh '978 does not disclose that the formula f4-f5 must be satisfied in order to obtain the average grain diameter of 200 μm or less during melt-solidification of casting, as claimed (Applicant's specification, ¶ [0034]).

Thirdly, hypothetically, even if Parikh '978 were to have an alloy composition similar to the claimed alloy, as alleged by the Examiner, this assumption does not support the conclusion that the Parikh alloy would have the claimed metal structure. In fact, the metal structure of alloys is very complicated and determined not only by the composition of alloys but also by the conditions under that the alloys are treated, such as temperature and pressure. For example, Figs. 1-4 in U.S. Patent 4,055,445 to Pops, filed herewith as "Exhibit E," show equilibrium diagrams of metal structures of Cu-Si-Zn alloys. As can be clearly seen, the metal structures of the Cu-Si-Zn alloys are totally different from one another depending on temperature even when the Cu-Si-Zn alloys have an identical alloy composition.

Fourthly, one having ordinary skill in the art would know that the Parikh alloy does not include the claimed K phase and/or γ phase in its metal structure. Specifically, these K and γ phases are Si-rich hard phases, and thus when cutting, they act as a stress concentration source and generate thin cutting chips of a shear type in the claimed casted copper alloy.

Applicant's specification, ¶ [0033]. Therefore, these hard and easy to be chipped features resulting from the K and γ phases are contradictory to the object of Parikh '978 which is to provide copper base alloys with a good combination of strength and bend properties. Parikh '978, col. 1, lines 8-10.

For these reasons, the Examiner's "inherency" argument regarding the "metal structure" recited by claims 1 and 140, and now new claim 141 is untenable and must be withdrawn.

With respect to the primary crystal being α phase recited by claim 8, the dendrite network comprising a divided crystalline structure and a two-dimensional grain shape recited by claim 10, and the peritittectic reaction generated during melt-solidification of casting recited by claim 140, the Examiner contends that since the copper alloy as taught by Parikh is made by the same method as taught in the instant specification, it would be expected that Parikh and the instant claims would result in the same properties and the same phases (Office Action, dated March 3, 2010, at 4, lines 8-11 and at p. 6, lines 1-3). The Examiner's inherency arguments with respect to claims 8, 10 and 140 are improper and untenable, and must be withdrawn, for the following reasons.

In this case, Parikh '978 does not teach, or suggest, the primary crystal being α phase recited by claim 8, the dendrite network comprising a divided crystalline structure and a two-dimensional grain shape recited by claim 10, or the peritittectic reaction generated during melt-solidification of casting recited by claim 140. Secondly, Parikh '978 does not disclose sufficient facts from which a person of ordinary skill in the art could conclude that the aforementioned features are the natural result, and not merely a possibility or a mere probability, of the process disclosed by Parikh '978. Further, the aforementioned claimed features can only be obtained in the casted copper alloy having an average grain diameter of 200 μm or less obtained during the melt-solidification of the casting process, as presently

claimed (Applicant's specification, ¶¶ [0034], [0088] and [0089], and Tables 16 and 18). These claimed features cannot be obtained in the process disclosed by Parikh '978, i.e., a conventional process including hot-working and recrystallization after casting.

For these reasons, the Examiner's "inherency" arguments regarding subject matter of claims 8, 10 and 140 are untenable and must be withdrawn.

New independent claim 141 is independently patentable, because Parikh '978 does not disclose the additional claimed features, i.e., the cooling rate of a range from 10^{-2} to 10^{4}°C/sec, the start temperature of casting at 20 to 250°C, and the Zr form added in a form of Cu-Zr alloy or Cu-Zn-Zr alloy. According to a preferred embodiment of the present invetion these additional features claimed need to be satisfied for providing the "casted copper alloy" with claimed metal structure and grain size. Applicant's specification, ¶¶ [0033], [0048], [0046] and [0047]. However, there are <u>no</u> teachings and/or suggestions provided by Parikh '978 regarding that the additional features recited by new claim 141.

For all of the above reasons, Parikh '978 does not anticipate subject matter of claims 1 and 140, and new claim 141. Claims 3, 5, 7, 8, 10, 11, 13, 16, 26, 27, 29, 35, 37-42, 44, 45, 47, 51, 54, 56, 57, 60, 70, 72 and 134-139 are all directly or indirectly dependent claim 1. Thus, these claims are patentable for at least the same reason as claim 1, discussed above.

2. <u>The Section 103 Rejection</u>

A <u>prima facie</u> case of obviousness requires a showing that the scope and content of the prior art teaches each and every element of the claimed invention, and that the prior art provides some teaching, suggestion or motivation, or other legitimate reason, for combining the references in the manner claimed. <u>KSR International Co. v. Teleflex Inc.</u>, 127 S.Ct. 1727, 1739-41 (2007); <u>In re Oetiker</u>, 24 U.S.P.Q.2d 1443 (Fed. Cir. 1992).

In this case, the Examiner has failed to establish a prima facie case of obviousness against Applicant's claimed invention because the combination of Parikh '978, and/or Yamazaki '349, and/or Oishi '912, and/or Ohno '204, fails to teach, or suggest, each and every limitation of the claims.

i. The Combination of Parikh '978 and Yamazaki '349

Neither Parikh '978 nor Yamazaki '349, alone or in combination, teaches a prima facie case of obviousness against Applicant's claimed invention, including claim 2, claims 18-20 and 73-75, and new independent claim 141, for the following reasons.

a. Parikh '978

Parikh '978 is discussed above.

As conceded by the Examiner (Office Action, dated March 3, 2010, at 6, lines 16-17, at p. 16, lines 21-22 and at 18, lines 7-8, and at 42, lines 15-16, at 22, lines 19 and at 23, lines 15-16), Parikh '978 does not teach, or suggest, the limitation of **claim 2**, namely, (i) the content of Te: 0.01 to 0.45 mass%.

Parikh '978 also does not teach, or suggest, for example, (ii) the limitations of **claim 2** other than the limitation of the content of Te: 0.01 to 0.45 mass%; the limitation of **claims 18 and 73**, namely, (iii) the dendrite network having a divided crystalline structure and the two dimensional grain shape; the limitation of **claims 19 and 74**, namely, (iv) the specific solid phase fraction; the limitation of **claims 20 and 75**, namely, (v) the cast having a near net shape; or the limitations of **new independent claim 141**, including, (vi) the additional conditions such as cooling rate, the start temperature of casting, and the Zr form.

b. <u>Yamazaki '349</u>

Yamazaki '349 discloses a copper-based alloy which is suitable for use in semiconductor lead frames, automobile radiator fins, and the like. Yamazaki '349, col. 1, lines 6-9. The copper-based alloy as shown in Yamazaki '349 comprises 0.001 percent to 0.02 percent of tellurium, 0.05 percent to 0.3 percent of one element selected from iron and chromium, and 0 percent to 0.01 percent of phosphorous with the balance being copper and incidental impurities. Yamazaki '349, Abstract.

Yamazaki '349 does not teach, or suggest, for example, (i) the limitations of **claim 2** other than the limitation of the content of Te: 0.01 to 0.45 mass%; the limitation of **claims 18 and 73**, namely, (ii) the dendrite network having a divided crystalline structure and the two dimensional grain shape; the limitation of **claims 19 and 74**, namely, (iii) the specific solid phase fraction, the limitation of **claims 20 and 75**, namely, (iv) the cast having a near net shape, or the limitations of **new independent claim 141**, including, (v) the additional conditions such as cooling rate, the start temperature of casting, and the Zr form.

c. <u>Summary of the Disclosures</u>

Neither Parikh '978 nor Yamazaki '349, alone or in combination, teaches, or suggests, the numerous limitations, disclosed above, of claims 2, 18, 20, 73, 74, 75, or new claim 141.

With respect to the content of Te: 0.01 to 0.45 mass% recited by claim 2, the Examiner contends that it would have been obvious to incorporate tellurium in the amount as taught by Yamazaki into the alloy as taught by Parikh because Yamazaki teaches tellurium improves the heat resistance of the alloy. Applicant disagrees.

A proper rejection under Section 103 requires showing (1) that a person of ordinary skill in the art would have had a legitimate reason to attempt to make the composition or device, or to carry out the claimed process, and (2) that the person of ordinary skill in the art

would have had a reasonable expectation of success in doing so. PharmaStem Therapeutics, Inc. v. ViaCell, Inc., 491 F.3d 1342, 1360 (Fed. Cir. 2007). In this case, the Examiner has failed to establish any legitimate reason to justify the combination of Parikh '978 and Yamazaki '349. In addition, the Examiner has failed to demonstrate that a person of ordinary skill in the art would have had a reasonable expectation of success of arriving at Applicant's claimed invention even if the combination of Parikh '978 and Yamazaki '349 were made.

The content of Te: 0.001 to 0.02% in the alloy of Yamazaki '349 may overlap the content of Te: 0.01 to 0.45 mass% of the casted alloy recited by claim 2. However, the purpose of adding Te into the Yamazaki alloy is clearly different from the purpose of adding Te into the claimed alloy. Te is added in the Yamazaki alloy for improving heat resistance (Yamazaki '349, col. 3, lines 34-42), whereas Te is added in the claimed alloy in order to improve machinability (Applicant's specification, ¶ [0035]). Further, Yamazaki '349 does not disclose other limitations of claim 2, e.g., the relations of f0 to f3 and f6 to f7, the metal structure and the relations of f4 to f5, and the average grain size of 200 μm or less in the macrostructure obtained during melt-solidification of casting.

Therefore, a person of ordinary skill in the art would have no legitimate reason to add Te disclosed by Yamazaki '349 into the Parikh alloy to form a copper alloy with good machinability. Even if the improper combination of Parikh '978 and Yamazaki '349 were made, there would have had no reasonable expectation of success of arriving at the "casted copper alloy" having, for example, an average grain diameter of 200 μm or less in the macrostructure obtained during melt-solidification of casting, as recited in claim 2.

Claims 18 (and 73), 19 (and 74), and 20 (and 75), respectively, are independently patentable because neither Parikh '978 nor Yamazaki '349, alone or in combination, discloses the dendrite network having a divided crystalline structure and the two dimensional grain

shape recited by claim 18 (and 73), the specific solid phase fraction recited by claim 19 (and 74), and the cast having a near net shape recited by claim 19 (and 75).

Secondly, these features recited by claims 18-20 and 73-75 are surprising and unexpected to those skilled in the art. In particular, there are no teachings and/or suggestions provided by Parikh '978, Yamazaki '349 or any other of references of record regarding a semi-melted state of an alloy having, for example, grains in a circular shape or a near net shape, so as to achieve excellent fluidity and castability in the semi-melted state, as recited in claims 18, 20, 73 and 75.

It is well known in the art that dendrites are conventionally generated in a metal structure obtained when an alloy is melted and solidified by casting, and more specifically, in a semi-melted state during melt-solidification of casting, the dendrites grow to from a dendrite-network structure. Applicant's specification, ¶¶ [0010], [0043]. This dendrite network causes bad castability and deteriorates formability of casting. Applicant's specification, ¶¶ [0043], [0086]. Therefore, as would be appreciated by persons of ordinary skill in the art, conventional mixing methods such as electromagnetic or mechanical mixing including hot-working, after casting, have been utilized to break the dendrite network. Applicant's specification, ¶ [0039].

However, the dendrite network of the copper alloy according to claims 18-20 and 73-75 of the present application has a divided crystalline structure in a semi-melted state of a solid phase fraction of 30 to 80%, wherein the solid phase has, for example, grains in a circular shape or a near net shape. See the conditions (12) and (14) of ¶ [0021] in Applicant's specification. Therefore, fluidity or castability of the claimed copper alloy is significantly improved even in the semi-melted state thereof. Applicant's specification, ¶¶ [0032], [0043], [0092], [0093].

Specifically, Applicant's specification shows a comparison between the alloy of Example 4 having excellent castability and the alloy of Comparative Example 202 having bad castability. Applicant's specification, ¶ [0086]. Before measuring castability, the respective alloy is heated up to a semi-melted sate having solid phase fraction of about 60% as recited by claims 19 and 74. Then, castability of the respective alloy is measured and listed, for example, as excellent castability where an average grain diameter of solid phase fraction of about 60% is 150 μm or less, or as bad castability where a dendrite network is formed. Applicant's specification, ¶ [0086]. FIG. 3, a photomicrograph of a semi-melted state of the copper alloy Example 4, shows grains in a circular shape and a near circular shape having excellent castability, whereas FIG. 4, a photomicrograph of a semi-melted state of the copper alloy Comparative Example 202, shows a dendrite network having bad castability. Also see Tables 19 and 23 in Applicant's specification.

Therefore, one having ordinary skill in the art would not be motivated by Parikh '978, Yamazaki '349 or any other of references of record to produce the metal structure having, for example, grains in a circular shape or a near net shape in a semi-melted state of a solid phase fraction of 30 to 80%, as recited by claims 18 (and 73) and 20 (and 75), more specifically, the metal structure having an average grain diameter of 150 μm or less in a in a semi-melted state of a solid phase fraction of 60%, as recited by claim 19 (and 74), because these features, as presently claimed, are well beyond the common knowledge of those skilled in the art.

New independent claim 141 is independently patentable, because neither Parikh '978 nor Yamazaki '349, discloses the additional features, i.e., the cooling rate of a range from 10^{-2} to 10^{4}°C/sec, the start temperature of casting at 20 to 250°C, and the Zr form added in a form of Cu-Zr alloy or Cu-Zn-Zr alloy.

For all of the above reasons, the combination of Parikh '978 and Yamazaki '349 does not render obvious subject matter of claim 2, claims 18-20 and 73-75, and new independent claim 141.

ii. The Combination of Parikh '978 in view of Yamazaki '349 and Oishi '912

Neither Parikh '978, Yamazaki '349, nor Oishi '912, teaches a prima facie case of obviousness against Applicant's claimed invention, including claims 14 and 50, and new independent claim 141, for the following reasons.

a. The Combination of Parikh '978 and Yamazaki '349

The combination of Parikh '978 and Yamazaki '349 is discussed above.

As conceded by the Examiner (Office Action, dated March 3, 2010, at 16, lines 21-22 and at 18, lines 7-8), neither Parikh '978 nor Yamazaki '349, alone or in combination, teaches, or suggests, as recited in **claims 14 and 50**, (i) "wherein, when the plastic worked material is cut by a lathe using a bite of a rake angle of -6° and a nose radius of 0.4 mm under a condition of a cutting speed of 80 to 160 m/min, a cutting depth of 1.5 mm and a feed speed of 0.11 mm/rev, a generated cut chip is a cut worked material taking a small segment shape of a trapezoidal or triangular shape, and a tape or acicular shape having a length of 25 mm or less."

Also, as discussed above, neither Parikh '978 nor Yamazaki '349, discloses, the limitations of **new independent claim 141**, including, (ii) the additional conditions such as cooling rate, the start temperature of casting, and the Zr form.

b. Oishi '912

Oishi '912 discloses copper/zinc alloys having low levels of lead and good machinability," which pertains to free-cutting copper alloy that comprises: (a) 69 to 79 percent, by weight, of copper, (b) 2.0 to 4.0 percent, by weight, of silicon, (c) 0.02 to 0.4, by weight, of lead, and (d) the remaining percent, by weight, of zinc. Oishi '912, Abstract.

Oishi '912 does not teach, or suggest, the limitations of **claims 1 and 2** on which claims 14 and 50 depend, namely, **(i)** "a casted copper alloy, ... wherein the copper alloy has a metal structure that contains α phase and one or more additional phases selected from the group consisting of (i) K phase, (ii) γ phase, (iii) K phase and γ phase, (iv) β phase, and (v) μ phase, and having relation of, in terms of a content of a phase b, [b]%, in an area rate, $f4 = [\alpha] + [\gamma] + [K] \geq 85$ and $f5 = [\gamma] + [K] + 0.3[\mu] - [\beta] = 5$ to 95," and **(ii)** " the copper alloy has an average grain diameter of 200 μm or less in a macrostructure obtained when melted and solidified during casting."

Oishi '912 also does not teach, or suggest, the limitations of **new independent claim 141**, including, **(iii)** the additional conditions such as cooling rate, the start temperature of casting, and the Zr form.

For example, Oishi '912 discloses a phase composition composed of α phase, β phase, and one phase selected from the group consisting of γ phase, a κ phase and a μ phase. Oishi '912, ¶ [0015]. However, the phase composition disclosed by Oishi '912 is one obtained after hot extrusion (Oishi '912, ¶¶ [0048] and [0052]), but <u>not</u> after casting. Therefore, a person of ordinary skill in the art would not be able to employ the hot extruded copper alloy disclosed by Oishi '912 to create grains as small as 200 μm in the macrostructure obtained during melt-solidification of casting, as recited in claims 1 and 2 on which claims 14 and 50 depend, respectively.

New independent claim 141 is independently patentable, because Oishi '912 does not disclose the additional features, i.e., the cooling rate of a range from 10^{-2} to 10^4°C/sec, the start temperature of casting at 20 to 250°C, and the Zr form added in a form of Cu-Zr alloy or Cu-Zn-Zr alloy.

c. <u>Summary of the Disclosures</u>

Neither Parikh '978, Yamazaki '349, nor Oishi '912, alone or in combination, teaches or suggests, the limitations of **claims 1 and 2** on which claims 14 and 50 depend, namely, **(i)** "a casted copper alloy, ... wherein the copper alloy has a metal structure that contains α phase and one or more additional phases selected from the group consisting of (i) K phase, (ii) γ phase, (iii) K phase and γ phase, (iv) β phase, and (v) μ phase, and having relation of, in terms of a content of a phase b, [b]%, in an area rate, $f4 = [\alpha] + [\gamma] + [K] \geq 85$ and $f5 = [\gamma] + [K] + 0.3[\mu] - [\beta] = 5$ to 95," and **(ii)** " the copper alloy has an average grain diameter of 200 µm or less in a macrostructure obtained when melted and solidified during casting," and the limitations of **new independent claim 141**, including, **(iii)** the additional conditions such as cooling rate, the start temperature of casting, and the Zr form.

For all of the above reasons, the combination of Parikh '978 (and/orYamazaki '349) and Oishi '912 does not render obvious subject matter of claims 1 and 2 on which claims 14 and 50 depend, respectively, and new independent claim 141.

iii. <u>The Combination of Parikh '978 in view of Yamazaki '349, Oishi '912 and Ohno '204</u>

Neither Parikh '978, Yamazaki '349, Oishi '912, nor Ohno '204, teaches a <u>prima facie</u> case of obviousness against Applicant's claimed invention, including claims 15, 64 and 65, and new independent claim 141, for the following reasons.

a. <u>The Combination of Parikh '978, Yamazaki '349 and Oishi '912</u>

The combination of Parikh '978, Yamazaki '349 and Oishi '912 is discussed above. As conceded by the Examiner (Office Action, dated March 3, 2010, at 22, lines 19-20, at 23, lines 15-16, and at 42, lines 15-16), Parikh '978, Yamazaki '349, or Oishi '912, either alone or in combination, does not teach, or suggest, as recited in **claims 15, 64 and 65**, (i) "wherein, the casting is a wire, a rod, or a hollow bar cast by horizontal continuous casting, upward casting or up-casting."

Also, as discussed above, neither Parikh '978, Yamazaki '349, nor Oishi '912, discloses the limitations of **new independent claim 141**, including, (ii) the additional conditions such as cooling rate, the start temperature of casting, and the Zr form.

b. <u>Ohno '204</u>

Ohno '204 discloses continuous metal casting of a metal ingot. Ohno '204, col. 1, lines 6-8.

Ohno '204 does not teach, or suggest, the limitations of **claims 1, 2 and 3** on which claims 15, 64 and 65 depend, namely, (**i**) "a casted copper alloy, ... wherein the copper alloy has a metal structure that contains α phase and one or more additional phases selected from the group consisting of (i) K phase, (ii) γ phase, (iii) K phase and γ phase, (iv) β phase, and (v) μ phase, and having relation of, in terms of a content of a phase b, [b]%, in an area rate, f4 $= [\alpha] + [\gamma] + [K] \geq 85$ and f5 $= [\gamma] + [K] + 0.3[\mu] - [\beta] = 5$ to 95," and (**ii**) " the copper alloy has an average grain diameter of 200 μm or less in a macrostructure obtained when melted and solidified during casting."

Ohno '204 also does not teach, or suggest, limitations of **new independent claim 141**, including, **(iii)** the additional conditions such as cooling rate, the start temperature of casting, and the Zr form.

For example, Ohno '204 discloses continuous metal casting, in a downward, upward, horizontal or other direction, of an ingot of a metal or alloy. Ohno '204, col. 2, lines 9-14. However, Ohno '204 does not pertain to a Cu-Si-Zn alloy of Applicant's claimed invention and is, therefore, <u>not</u> relevant to the subject matter of Applicant's claimed invention.

New independent claim 141 is independently patentable, because Ohno '204 does not disclose the additional features, i.e., the cooling rate of a range from 10^{-2} to 10^{4}°C/sec, the start temperature of casting at 20 to 250°C, and the Zr form added in a form of Cu-Zr alloy or Cu-Zn-Zr alloy.

c. <u>Summary of the Disclosures</u>

Neither Parikh '978, Yamazaki '349, Oishi '912, nor Ohno '204, alone or in combination, teaches, or suggests, the limitations of **claims 1, 2 and 3** on which claims 15, 64 and 65 depend, respectively, namely, **(i)** "a casted copper alloy, ... wherein the copper alloy has a metal structure that contains α phase and one or more additional phases selected from the group consisting of (i) K phase, (ii) γ phase, (iii) K phase and γ phase, (iv) β phase, and (v) μ phase, and having relation of, in terms of a content of a phase b, [b]%, in an area rate, $f4 = [\alpha] + [\gamma] + [K] \geq 85$ and $f5 = [\gamma] + [K] + 0.3[\mu] - [\beta] = 5$ to 95," and **(ii)** " the copper alloy has an average grain diameter of 200 µm or less in a macrostructure obtained when melted and solidified during casting," and the limitations of **new independent claim 141**, including, **(iii)** the additional conditions such as cooling rate, the start temperature of casting, and the Zr form.

For all of the above reasons, the combination of Parikh '978 (and/orYamazaki '349 and/or Oishi '912) and Ohno '204 does not render obvious subject matter of claims 1, 2 and 3 on which claims 15, 64 and 65 depend, respectively, and new independent claim 141.

III. CONCLUSION

In view of the above amendments and arguments, the Examiner has failed to establish a prima facie case of anticipation and/or obviousness against Applicant's claimed invention.

For all of the above reasons, claims 1-8 and 10-141 are in condition for allowance, and a prompt notice of allowance is earnestly solicited.

The below-signed attorney for Applicant welcomes any questions.

Respectfully submitted,

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